Maternal Characteristics and Fetal-Infant Mortality in Franklin County

Honors Research Thesis

Presented in Partial Fulfillment of the Requirements for graduation "with Honors Research Distinction in Public Health" in the undergraduate colleges of The Ohio State University

by
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Abstract:

In 2014 the infant mortality rate in Franklin County was 8.4 deaths per 1,000 births compared to the national rate of 6 deaths per 1,000 births. There is much evidence in peer reviewed journals that suggests links between various maternal health characteristics and poor birth outcomes. Due to the high number of deaths in Franklin County, it is important to use the county's data as a case study in order to learn more about the relationship between maternal characteristics and fetal-infant mortality. The objective of this study is to analyze the data set compiled by the Franklin County Fetal- Infant Mortality Review Program at Columbus Public Health. The program received birth and death records from the Office of Vital Statistics. The data collected about the mothers (n=279) includes demographics, previous birth history and socioeconomic status. In this study, four categories of death are analyzed: 1) fetal deaths (death before birth) less than 24 weeks gestation; 2) fetal deaths greater than 24 weeks gestation; 3) infant deaths (death under one year of age) during the first 27 days of life (neonatal); and, 4) infant deaths between 27 days and a year (post-neonatal). Analysis shows that the type of death is significantly associated ($p<.01$) with obesity and whether or not the mother is enrolled in the Women, Infants, and Children (WIC) program. This study also found that African American women experience fetal-infant death at a proportionally higher level than other races because they account for only 17% of births in Franklin County, but account for 43% of fetal-infant deaths. In conclusion, this data shows that more programming is needed in Franklin County—specifically, programming that focuses on healthy weight and proper nutrition during pregnancy while remaining culturally and racially focused.

Introduction/Background:

In 2014, the infant mortality rate in Franklin County was 8.4 deaths per 1,000 births compared to the national rate of 6 deaths per 1,000 births. Because of this fact, Franklin County has a need for further study on fetal-infant mortality. In January of 2014, the Franklin County Fetal-Infant Mortality Review (FIMR) was established as a program in the department of Maternal Health at Columbus Public Health. The FIMR program receives information from the Office of Vital Statistics (which is entered into a master data set) and uses this information to identify special cases of mothers who lost a child and have met other specific requirements. After retrieving interviews and more information about the mother's situation, the case is presented to the case review team. The case review team then makes suggestions and the community action team attempts to implement these suggestions. In this study, we aim to use the information collected by the FIMR program to analyze different factors related to fetal-infant mortality and make suggestions for solutions to the problem.

There has been a lot of literature written on the topic of birth outcomes and maternal health characteristics. Two of the most common factors studied in the literature are smoking status of the mother and weight of the mother. The use of tobacco products during pregnancy has been shown to be associated with many poor birth outcomes including: placenta previa, abruptio placentae, premature rupture of the membranes, preterm birth, intrauterine growth restriction and sudden infant death syndrome (SIDS). "Approximately 15–20% of women smoke during pregnancy. It has been suggested that smoking is responsible for 15% of all preterm births, 20–30% of all infants of low birthweight, and a 150% increase in overall perinatal mortality" (Andres and Day 2000). Many studies also suggest that if the mother is overweight or obese, this can be a risk factor for fetal or infant losses. One study on this topic states: "Even modest increases in maternal BMI were associated with increased risk of fetal death, stillbirth, and neonatal, perinatal, and infant death. Weight management guidelines for women who plan

pregnancies should take these findings into consideration to reduce the burden of fetal death, stillbirth, and infant death" (Aune et al. 2014). Through a meta-analysis, Aune et al. essentially found that there seems to be a dose-response of maternal BMI and various poor birth outcomes. Another study looked at how smoking interacts with anemia in mothers with relation to sudden infant death syndrome. Bulterys et al. found that infants born to mothers who were anemic and smoked 10 or more cigarettes per day had the highest odds of sudden infant death syndrome. Interestingly enough, infants born to mothers who smoked less than 10 cigarettes per day but were anemic had a higher odds of sudden infant death syndrome than non-anemic mothers smoking more than 10 cigarettes per day.

Anderson and Cook conducted a review of 34 studies that analyzed maternal prenatal smoking and sudden infant death syndrome. From their review, they found that 31 of the studies showed a significant association between maternal prenatal smoking and SIDS. Fleming and Blair attempted to pick apart the risk of SIDS and smoking to see if it matters who is smoking in the infant's environment. According to them, "Maternal smoking during pregnancy is clearly the main source of tobacco smoke exposure, but this evidence suggests a smaller but independent effect from the mother and other household members after the infant is born" (Fleming and Blair 723). Another interesting aspect of SIDS is it's possible link to the type of sleep the infant is experiencing. Gould et al. studied sets of twins and singleton births and found that infants who were at high risk for SIDS due to other factors demonstrated abnormalities in their sleep-states. "The source of these abnormalities is environmental rather than genetic and most likely occurs prenatally. During the critical period for SIDS, infant sleep begins to coalesce from a series of naps to more prolonged night time sleep periods that last up to 8 hours. We believe that the ability to maintain physiologic homeostasis during prolonged sleep is a challenge facing infants who are epidemiologically at risk for sudden infant death" (Gould et al. 74-75).

A meta-analysis performed by Kramer looked at English and French medical literature from 1970 to 1984 about factors that cause low birth weight. It is widely recognized that low birth weight is a primary factor in poor birth outcomes. "Factors with well-established direct causal impacts on intrauterine growth include infant sex, racial/ethnic origin, maternal height, pre-pregnancy weight, paternal weight and height, maternal birth weight, parity, history of prior low-birth-weight infants, gestational weight gain and caloric intake, general morbidity and episodic illness, malaria, cigarette smoking, alcohol consumption, and tobacco chewing" (Kramer 663). The analysis also revealed differences in determinants for developing versus developed countries. Another meta-analysis completed by McDonald et al. was done by searching two literature databases. Medline was searched for 1950 to 2009 and Embase was searched for 1980 to 2009. The analysis showed that overweight and obese women have an increased risk of a preterm birth before 32 weeks and of induced preterm birth before 37 weeks. The analysis also found that overweight and obese women had a higher overall rate of preterm birth before 37 weeks. A study done by Wingate and Barfield looked at the fetal deaths and first-day infant deaths from 1990-1991 compared to 2001-2002 found that there are significant racial disparities in overall improvements in mortality. While the fetal mortality rate declined among whites and Hispanics, the fetal mortality rate increased for blacks. Overall, the black to white fetal mortality rate ratio increased over time.

Fetal-infant mortality is a well-studied topic, but there are still factors that are not well understood. This study will use only data on deaths in Franklin County to analyze how the categories of death (fetal or infant) are related to specific maternal factors.

Methods:

In this study we used an existing data set to complete a retrospective cross-sectional study. The data was collected by the Fetal-Infant Mortality Review program of Franklin County, which is housed in Columbus Public Health. The data was retrieved from birth and death records

provided by the Office of Vital Statistics and it was compiled for 279 mothers who lost a baby under the age of one in Franklin County. The data set includes information about both the mother of the baby (MOB) and the baby. The information about the MOB includes demographic information, marital status, educational status, information about previous poor birth outcomes or losses, smoking status, whether or not MOB is enrolled in the Women, Infants, and Children (WIC) program, and information on when prenatal care (PNC) was started and how many visits the MOB had. The set also includes the baby's birth weight and gestational age, sex, cause of death and whether the loss was infant (after delivery) or fetal (in utero). The data was analyzed using JMP11. Every factor was analyzed by the four categories of death in this study. The categories are: 1) fetal deaths (death before birth) less than 24 weeks gestation; 2) fetal deaths greater than 24 weeks gestation; 3) infant deaths (death under one year of age) during the first 27 days of life (neonatal); and, 4) infant deaths between 27 days and a year (post-neonatal). Chi-squared tests were used to determine statistical significance.

Results:

The mothers in the data set are categorized as white (42%), black (43%), and other (14%) and of these categories, 7% align as of Hispanic origin. The average age of the mothers of the babies (MOB) is 29. Additionally, about 6% of the MOBs are teenagers. The data set includes 14% post-neonatal deaths, 40% neonatal, 27% fetal 24+ weeks and 20% fetal <24 weeks deaths. About 30% of the mothers in the data set are on the Women, Infants, and Children (WIC) program. The mothers are categorized as 53% unmarried and 18% have less than a high school education. As for previous birth outcomes, 16% of the mothers had another baby within the last 18 months and 13% had had a previous preterm birth. The mothers were 20% smokers and 29% obese (BMI $\geq$ 30). We were also interested in prenatal care (PNC)—specifically when the mother entered PNC and how many visits she had. The mothers entered PNC 68% in the first trimester, 21% in the second, 1% in the third and the remaining percentage is of unknown status.

Obesity was a characteristic of the mother of baby (MOB) that was categorized as a yes or no response in the data set. When analyzed by type of death, there was a significant difference in obesity status in the death categories ($p=0.0032$). There was a significantly higher proportion of obese women in the fetal <24 weeks category with 56% of the death category being obese women compared to 44% of the category not obese. The trimester MOB entered prenatal care (PNC) was categorized as either first trimester, second trimester, third trimester or none and was also analyzed by type of death. There was a statistically significant difference for which trimester MOB entered PNC ($p=0.0345$), but because the expected counts for each subcategory of the analysis were not sufficient, this could potentially confound the results for this specific analysis. Similarly, when race/ethnicity was analyzed by type of death, there were certain expected counts that were not sufficient, but there was a significant difference in trimester MOB entered PNC and race/ethnicity. We saw that 80% of the white women in the study entered PNC in the first trimester compared to 57% of black women and 63% of other races.

WIC program status for MOB was characterized as a yes or no response in the data set. This factor was used as a proxy variable for income because the program is a need based nutritional supplement program. After analysis by type of death, there was a statistically significant difference in type of death by WIC status. We found that 84% of women in the fetal <24 weeks death category were not getting WIC compared to 16% of the women in this category getting WIC. Additionally, in the infant post-neonatal death category, 57% of women were on WIC compared to 43% not receiving WIC.

There were also some important findings on racial composition of the data set that must be noted. African American women made up 43% of the data set, but according to data collected by the Ohio Department of Health, African American women account for 17% of the births in Franklin County. Although no significant differences were found between race and most of the other factors, it is important to note that African American women are highly overrepresented in

the data set. Another small finding to note is that there were a proportionately higher number of Hispanic mothers in the fetal 24+ death category. Although this was not statistically significant, it is important to note for future directions in policies and programs.

Another important note about this study is that the analysis is comparing deaths to deaths because the data set is only comprised of the deaths in the county. This provides different information than comparing the differences of mothers who had babies that survived to those who had babies that died. For example, smoking status cannot be picked out as an important factor in birth outcomes, but we do know that 20% of the mothers who lost a baby were smokers and this percentage is just slightly higher than the 18% of women who smoke in Franklin County. Because we aren't comparing the mothers of babies who died to those who survived, we do not know the significance of this information.

Discussion:

Maternal health has serious implications for future generations. It is quite surprising that in 2014 Franklin County was still experiencing fetal and infant losses at a rate that is comparable to that of sub-Saharan Africa. There are clearly serious problems in Franklin County that need to be addressed in order to reduce the number of fetal and infant losses. The first big problem to discuss is racial disparity. As addressed in the results section, there is a higher proportion of African American women who are losing babies. In fact, in Franklin County, African American women are losing babies at two times the rate of white women. Another interesting finding from the data is that while 84% of white women get prenatal care in the first trimester, only 65% of black women in the study got prenatal care in the first trimester (see Figure 1). This is significant because getting prenatal care early on is a strong indicator of a healthy pregnancy. The first trimester is an important time for growth and getting prenatal care indicates that the mother is getting some guidance on how to take care of herself during her pregnancy in order to have a

healthy pregnancy and healthy baby. Prenatal care is also important for catching possible risk factors or complications for a woman's pregnancy.

An interesting thing to note is that when analyzing race by WIC status, there are no significant differences. This means that the racial disparity cannot be explained by socioeconomic status or income. There are also no significant differences between blacks and whites for other risk factors like smoking status, obesity status and education level. There were, however, significant differences between black and white women for having a previous preterm birth, being unmarried and trimester entered prenatal care (see Chart 1). We saw that significantly more black women had a previous preterm birth and are unmarried. The preterm birth factor is still speaking to the racial disparity that these women are experiencing. There is a need for more programming in Franklin County to specifically address black women and help them to have healthy pregnancies.

The next important discussion point is healthy maternal weight. As discussed in the background section, healthy maternal weight is an indicator for a healthy pregnancy. In the data set, 33% of the women were obese. The analysis showed that 56% of the women in the fetal <24 weeks death category were obese (see Figure 2). This is indicating that obesity is a risk factor for early pregnancy loss. There are two possible explanations. Firstly, this could be happening because obesity is an indicator of other health issues that can cause a mother to lose her baby such as diabetes or hypertension. Another explanation is that maternal obesity can affect the growth of the fetus and increase the risk of mortality. According to Wu et al., "Extensive studies have shown that maternal overnutrition retards placental and fetal growth, and increases fetal and neonatal mortality in rats, pigs, and sheep... Maternal obesity or overnutrition before or during pregnancy may result in fetal growth restriction and increased risk of neonatal mortality and morbidity in humans" (Wu et al. 2004).

The third interesting finding was that WIC status differed by type of death. In the post-neonatal death category, 57% of women were on WIC, which was significantly higher than those who were not on WIC (see Figure 3). The post-neonatal category is from 27 days of life to 1 year of life. This means that women on the WIC program are losing their babies later on compared to women not on WIC. This could be pointing to a lack of resources for poor women after giving birth.

Because of these findings, it is obvious that there are very specific problems that need to be addressed in Franklin County. Firstly, the racial disparity needs to be attacked head on. Additionally, programming should be focused on healthy weight and helping poor women. A strong effort needs to be made in this area of health because of its impacts on the future generation.

Limitations:

The biggest limitation of this study was that the data was only about the deaths in the county, so it's hard to establish a relationship between the different maternal factors and the birth outcomes. The cause of death was a write-in variable, so we were unable to categorize it nicely. Because of this, we could not do any analysis using the cause of death, which could give some good insight on the data.

Future Directions:

Because of the limitations, it will be important to compare the death data to the birth data to see what the differences are in maternal characteristics for the babies that survived compared to the babies that died. Additionally, it would be insightful to study the data longitudinally to see if the modern health care system is lowering the rates of fetal-infant mortality and/or if various programs such as Moms2B have any effect on the fetal-infant mortality rate. In order to test the efficacy of such programs, it is important to study the data longitudinally.

Conclusions:

There are obvious racial disparities in Franklin County that are causing African American women to have different (and worse) birth outcomes than white women and other races. To combat this and to attack the high rates of fetal-infant mortality in the county, more programming is needed. Specifically, the programming needs to be culturally sensitive and culturally specific. The programming should also be addressing healthy weight, and for low income women specifically, increasing knowledge and resources post-partum is vital. To sum it all up, the fetal-infant mortality rate in Franklin County needs to be viewed as a serious problem and we need to take more action to help mothers have healthy pregnancies and healthy babies.

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Appendix:

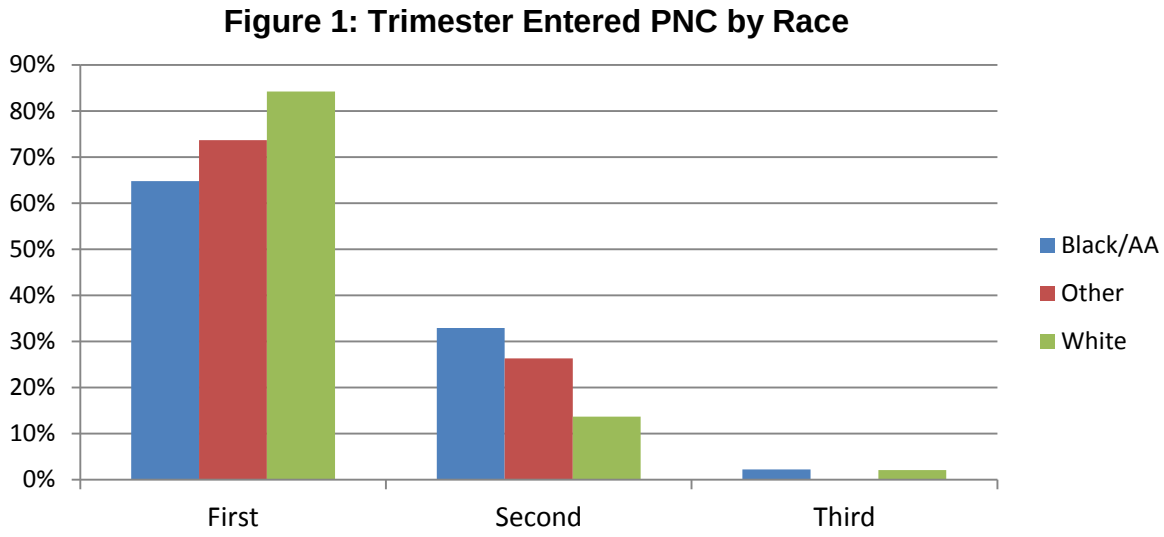
Figure 1: Trimester Entered PNC by Race
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
First
Second
Third
Black/AA
Other
White

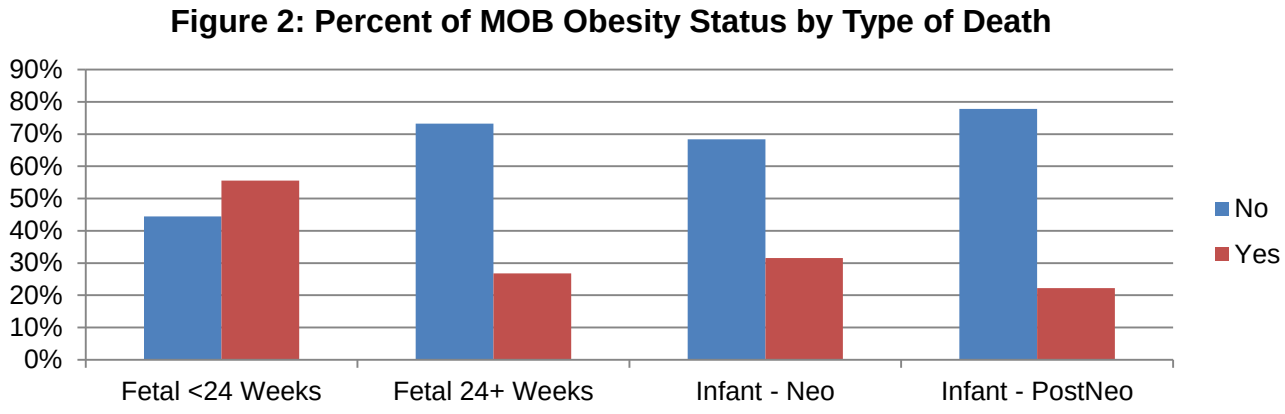
Figure 2: Percent of MOB Obesity Status by Type of Death
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Fetal <24 Weeks
Fetal 24+ Weeks
Infant - Neo
Infant - PostNeo
No
Yes

Figure 3: Percent of WIC Status by Type of Death

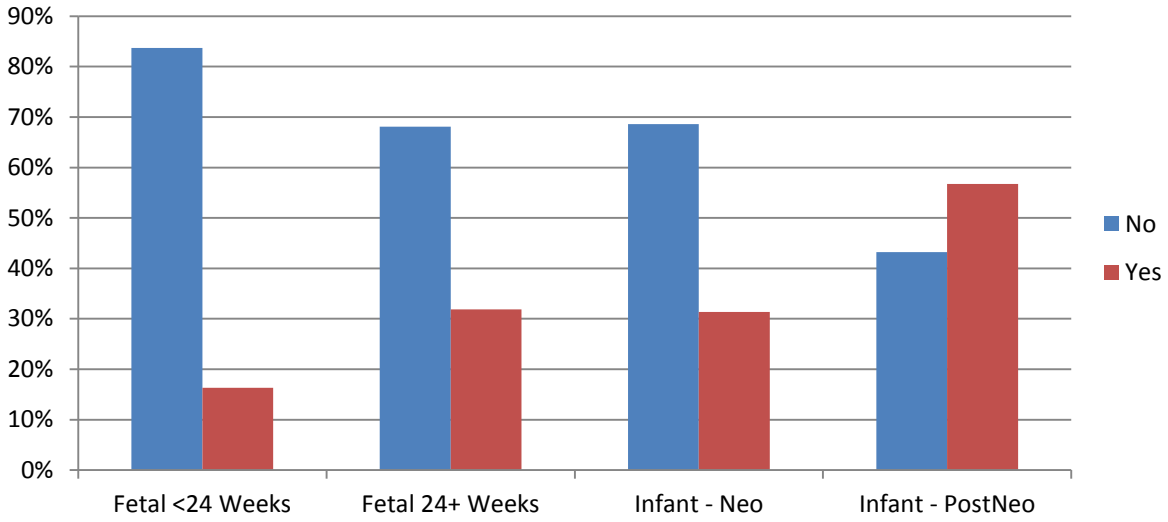

Chart 1: MOB Had Previous Preterm Birth by Race	No	Yes
Black/AA	80.70%	19.30%
White	92.44%	7.56%

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